RV METEOR

Cruise M176/2 RainbowPlume

1st September – 6th October 2021

Emden-Emden

1. Weekly Report (1st - 5th September2021)

The cruise M176/2 is part of the International GEOTRACES Programme as a process study. The overall aim of cruise M176/2 is to conduct a detailed geochemical sampling of the hydrothermal plume at the Rainbow vent field located at 36°13.80 N, 33°54.14 W, on the Mid-Atlantic Ridge (MAR). The deep ocean work will be complimented by biological surface ocean investigations of productivity and diazotrophy.

The cruise involves a range of national and international research groups and we have many different nationalities on board which creates a wonderful multi-cultural environment. The cruise is led by GEOMAR, and we have scientists involved from Jacobs University, the Universities of Kiel, Marseille, Lausanne, Xiamen, Minnesota, South Florida, and the South China Sea Institute of Oceanology, the Alfred Wegener Institute, and Woods Hole Oceanographic Institution.

The Rainbow field itself is well studied and time series data for the fluid chemistry indicates a very stable system over time, making it an ideal study site for our detailed plume study. The project will obtain a mechanistic and quantitative understanding of processes that set hydrothermal fluxes of trace elements and their isotopes (TEIs) to the deep ocean interior at

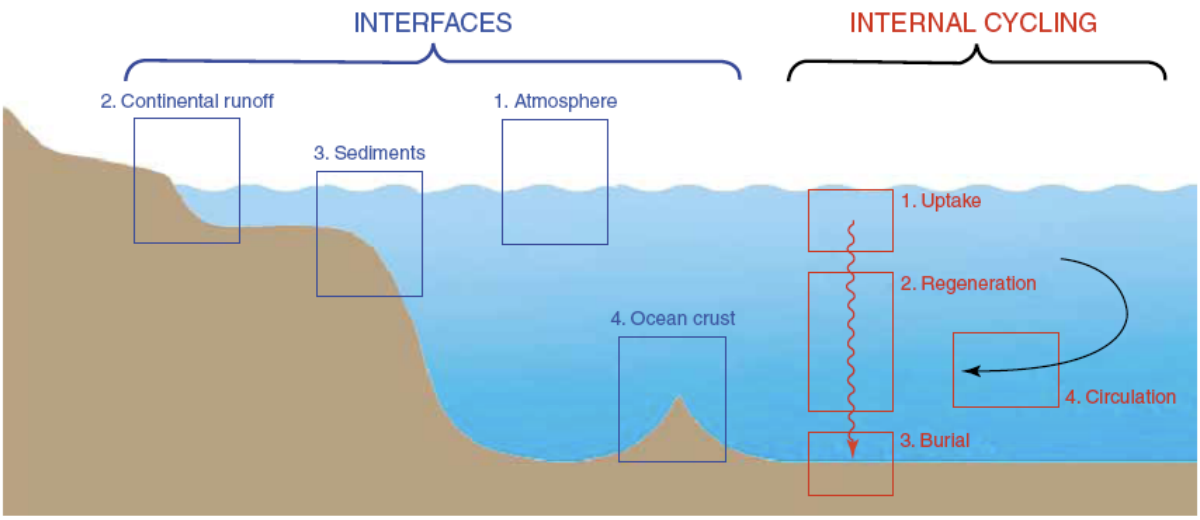

Fig. 1: A schematic representation of the four major boundaries at which micronutrients enter/leave the ocean, and the internal cycling that they undergo in the ocean.

MAR. This work will quantify TEIs fluxes from the ocean crust and determine their biogeochemical cycling and the plume spread in relationship to large scale ocean circulation in the N Atlantic in the vicinity of MAR. We will conduct detailed water column surveys in close vicinity to the vent field and up to 60 km distance to determine the fate of hydrothermally derived TEIs with increasing distance from the source, including an assessment of changes in physical and chemical speciation. We will assess to what extent TEIs are controlled by vent supply, particle removal processes and advection. Sampling of Ra, Th and He isotopes will help to quantify hydrothermal fluxes of TEI, assess removal strength, and fingerprint sources to elucidate TEI distributions. Atmospheric and deep water (micro)nutrient supply to the surface ocean will be assessed to investigate controls on microbial ecosystem functioning,

including productivity and diazotrophy. In addition, the role of dissolved organic nitrogen (DON) as a N source to phytoplankton will be assessed. The work will use GEOTRACES trace metal clean sampling and analysis approaches.

Our cruise M176/2 sails with a full complement of scientists, which is wonderful. We are still strongly affected by the COVID pandemic, with great care paid to hygiene during the cruise preparations, and a range of additional measures taken during the cruise.

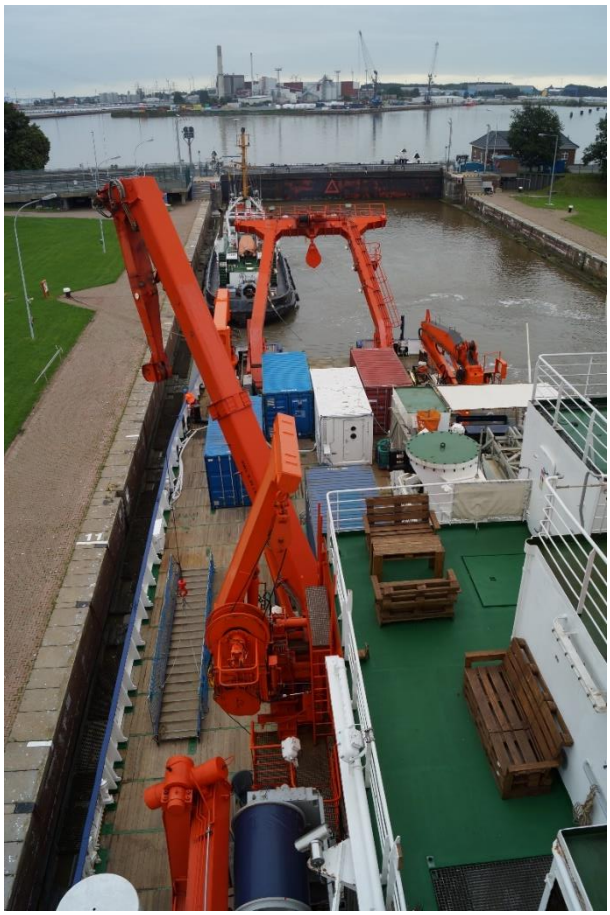

Fig. 2: METEOR in locks in Emden.

After setting up for two days in Emden, we sailed through the locks and out into the North Sea in the morning of September 1. The weather was very kind to our cruise participants, with light winds, and a pleasant temperature. We conducted a test station on September 4, which allows us to amend some of our equipment and protocols. Now we are in international waters, all our underway water sampling and data acquisition equipment is switched on, allowing us to start producing samples and data. Following a breezy Saturday night, we are now again in calm waters and progressing to our promised hydrothermal fields further south in sunny regions.

All the members of the RainbowPlume team are very grateful to the DFG, the German Research Fleet Coordination Centre at the Universität Hamburg, the shipping company BRIESE RESEARCH and LPL Projects + Logistics GmbH for providing their outstanding support to science and ship logistics which made this cruise possible.

RV METEOR at sea 45°N/33°W

Eric Achterberg

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